Patent
Attorney's Docket No. 83,099

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

OFFICIAL

In re Patent Application of	
Richard BECKMAN et al.	Group Art Unit: Unassigned
Application No.: 60/290,401	Examiner: Unassigned
Filed: May 11, 2001	
For: LOST 2 – A POSITIONING SYSTEM FOR UNDERWATER VESSELS	

SUPPLEMENTAL PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination on the merits kindly amend the above-identified application as follows:

IN THE SPECIFICATION

Kindly replace the current specification with the enclosed substitute specification.

IN THE CLAIMS

Kindly replace claims 1, 7 and 16 with the following amended claims.

1. (AMENDED) A system for the accurate determination of the position of an underwater vehicle comprising:

a sea borne position marker having a known position;

at least one underwater vehicle acoustically coupled to the single position marker;

a system observer comprising a state updater for predicting the underwater vehicle's position, χ_n, based on a past estimate of the underwater vehicle's position, $\chi_{n|n-1}$ and an estimate of the underwater vehicle's velocity over the sea bottom, and a maximum likelihood estimator, to estimate the underwater vehicle's position (MLE(n)), utilizing measured ocean depth at the underwater vehicle's position, bathymetry data and the underwater vehicle's predicted position based on a past estimate of the underwater vehicle's position and an estimate of the underwater vehicle' velocity over the sea bottom, χ_n in a single point position match;

an extended Kalman filter that takes state updater's estimate of the underwater vehicle's position, χ_n, and the maximum likelihood estimator's estimate of the underwater vehicle's position, MLE(n), and computes a linear Kalman filter position estimate at time (n), $\chi_{n|n}$; and

a range corrector that utilizes the linear Kalman filter position estimate at time (n), $\chi_{n|n}$, a sea borne position marker, and a measured slant range from the at least one submersible vehicle to the sea borne position marker and computes a final estimate of the at least one submersible vehicle's position.

7. (AMENDED) The system of claim 2 wherein said means for predicting the at least one underwater vehicle's position, based on a past estimate of the underwater vehicle's position and an estimate of the underwater vehicle's velocity over the sea bottom comprises a state velocity updater.

16. (AMENDED) A computer for the analytic determination of the position of at least one underwater vehicle acoustically coupled to a position marker having a known position using bathymetry data, positioning data, the underwater vehicle's velocity over the sea bottom, and a slant range from the position marker comprising:

a computer for computing

(a) a prediction of the underwater vehicle's position, χ_n, based on a past estimate of the underwater vehicle's position, $\chi_{n|n-1}$ and an estimate of the underwater vehicle's velocity over the sea bottom with a state updater,

(b) an estimate of the underwater vehicle's position (MLE(n)), utilizing measured ocean depth at the underwater vehicle's position, bathymetry data and the underwater vehicle's predicted position based on a past estimate of the underwater vehicle's position and an estimate of the underwater vehicle' velocity over the sea bottom, χ_n in a single point position match with a maximum likelihood estimator,

(c) a linear Kalman filter position estimate at time (n), $\chi_{n|n}$ using the state updater's estimate of the underwater vehicle's position, χ_n, and the maximum likelihood estimator's estimate of the underwater vehicle's position, MLE(n) with an extended Kalman filter, and